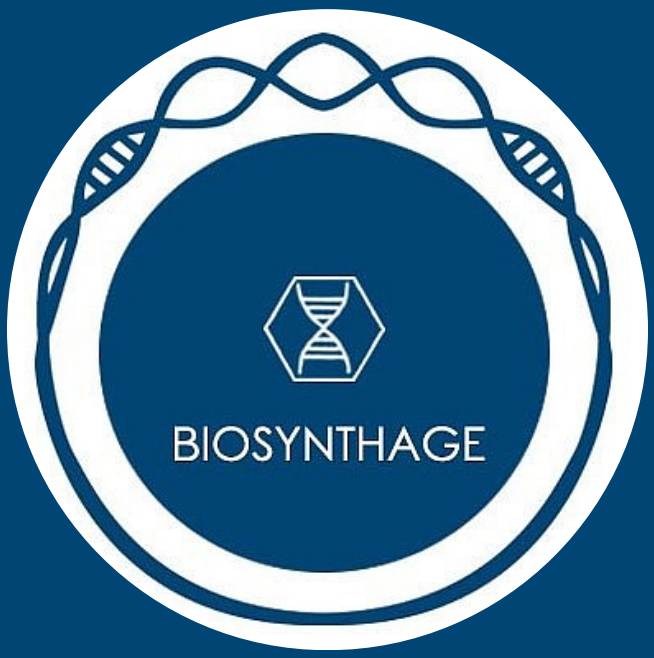
IGEM AND SYNTHETIC BIOLOGY HANDBOOK



UCL iGEM 2016

What is iGEM?

iGEM is an international synthetic biology competition. The competition, which over 300 teams enter, is a world championship for university students who are passionate about synthetic biology. UCL has an impressive record of success in the past having won numerous gold medals as well as the Best Supporting Entrepreneurship award, Best Supporting Art and Design, Best Policy and Practice Advance and the Best Supporting Software.

The idea is to change the DNA of any living organism (bacteria, yeast cell or even human cells) so that the living organism can be used to do something you want it to do. For example, we can change the DNA of a bacteria to produce a bright light in the dark or even engineer human cells to fight against cancer! The possibilities are endless!

Not only is it the science that defines the project, but also that we consider how the public will react to the project (as it will affect them in their lives!) also consider the ethical issues, social acceptance issues, sustainability issues, safety, security and many more. Will people be accepting of genetically modified bacteria to solve their issues?

What is UCL 2016 iGEM project?

UCL iGEM project this year will explore how we can use synthetic biology to increase our healthy life span. This means that we can change the DNA of bacteria to make humans live a healthier life for longer. Not only do we want to increase the healthy lifespan, but we want to also change the DNA of living organisms to solve some of the symptoms of ageing. Currently, we are looking into developing bacterial fillers to restore healthy teeth (a problem with the ageing population). Ageing themed iGEM project has never been explored before on iGEM and we are really excited to build new systems that solve the issues of the ageing population.

What is synthetic biology?

As explained before, Synthetic biology is all about engineering the DNA of a living organism so that it can be used to carry out a desired characteristic.

What is DNA?

Our bodies are made of complex 3D structures known as organs (lungs, heart), that are itself made of specialized tissues. The tissues itself are composed millions of cells. Each cell will have a nucleus which contains DNA.

DNA stands for Deoxyribonucleic acid. It is a double stranded helical molecule that carries information needed for the growth, development, reproduction and functioning of all cells hence is responsible for a functioning living organism.

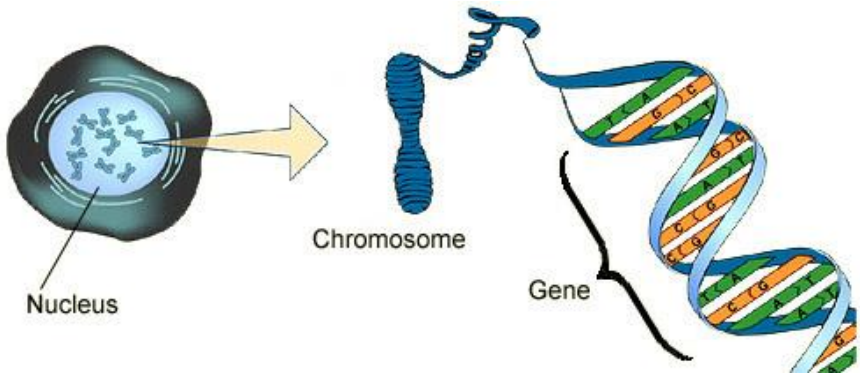


Figure 1: Shows a cell (with a nucleus), which has DNA within the nucleus of the cell.

A section of DNA is known as a gene. As DNA is made of bases, different arrangement of bases (that make up a gene) make certain proteins. Synthetic biology is all about adding a certain gene into the DNA of an organism to produce a desired protein (within the organism). For example, if we wanted to make bacteria light up, we would firstly isolate a gene which codes for a protein which causes a light producing chemical to be made. This gene would be incorporated into the DNA of the bacteria so that it can light up!

What is bacteria?

Bacteria is a living organism (that comes in all shapes and sizes), which is known to be the first life form that existed on earth! Most people still think that all bacteria are all bad for you. However, it is known that there are good bacteria living in your gut, on your skin and in your mouth that work together to help prevent the bad bacteria from causing harm to your body.

Some projects within the iGEM competition focus on engineering the good bacteria in the human body to produce proteins that have can enhance its attack against bad bacteria. For example, good bacteria in the mouth can be engineered to produce a toxin that destroys the bad bacteria on teeth that causes plaque.

What is a plasmid?

A plasmid is a circular piece of DNA that is only found in bacteria cells.

How can we genetically engineer bacteria to do something we want it to do?

Case study: Bacteria that produces a toxin that kills the bad bacteria that causes plaque on teeth

Firstly, we would isolate the gene (sequence of bases) that produces the toxin. The DNA of interest that is put into the vector is composed of a promotor region (the start of the gene sequence). The promotor sequence activates the production of the toxin. For example, we could have a promotor sequence which is only activates the gene of interest unless there is a certain molecule produced in the cell or by something simple as light (blue light promotor)

Next, the vector (the plasmid) is cut using a restriction enzyme (acts like scissors) and the gene of interest is put into the open vector. DNA ligase acts like a glue that sticks the gene of interest to the open vector producing a functional plasmid, that can now be put into a bacteria cell (and can be put onto teeth). This is actually one of our

ideas, where we are using a blue light promotor with a gene that produces a bacteriocins (toxin) that kills the bacteria causing plaque on teeth (only in the presence of blue light).

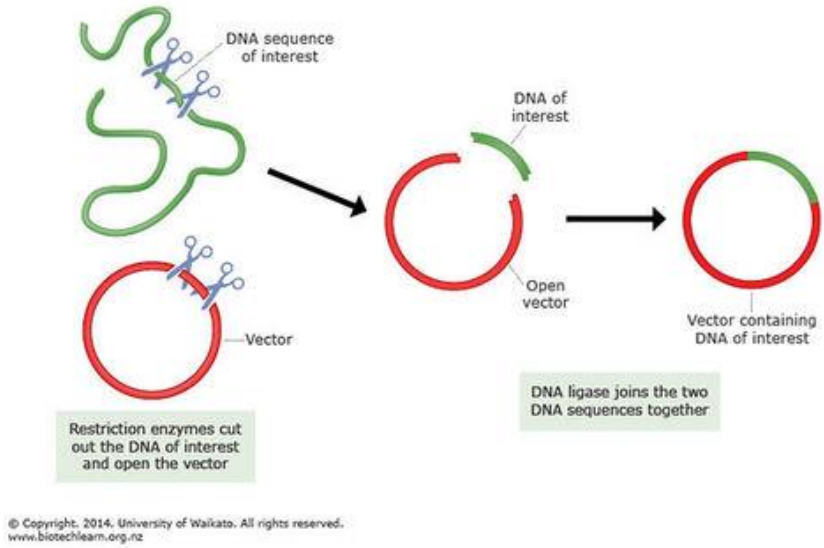


Figure 2: Diagram showing how a gene of interest (codes for a target protein that produces the desired characteristic) being put into a vector (the plasmid that will be put into a bacteria cell)

Figure 1: http://www.bbc.co.uk/staticarchive/678f62dce35d0fc7ef2333d6d3bfbf53744374ff.jpg Figure 2: http://biotechlearn.org.nz/var/biotechlearn/storage/images/themes/bacteria_in_biotech/images/cloning_dna/620043-1-eng-AU/cloning_dna_supersize_landscape.jpg